The presence of African Spoonbill *Platalea alba* in April 2015 and 2016 at the West Kleinemonde and East Kleinemonde estuaries in the Eastern Cape (South Africa)

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2017

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Figure 1. African Spoonbill at East Kleinemonde Estuary during inundated status (April 2015).

Figure 2. Study sites

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Figure 3. Aerial map of West Kleinemonde Estuary and East Kleinemonde Estuary.

Source: http://homes.mitula.co.za/homes/farms-kleinemonde (Accessed on 24 May 2016.)

ABSTRACT

African Spoonbill presence at two seemingly similar estuaries is multi-faceted. Short-term weather changes impact significantly on African Spoonbill social behaviour, in particular flock-size dynamics. High-frequency counts confirm inter- and intra-site movements in the short-term and its relation to long-term perspectives. Rainfall, estuarine mouth status and as a result, varying water level fluctuations in relation to micro-habitats, are variables that manifest in behavioural decisions that require further investigation at species-specific level. Indications are that such should take place in both intra- and inter-continental contexts against the background of new thinking regarding traditional conservation biology and environmental *praxis* that would benefit through close(r) association with e.g. social sciences.

Key words: estuary, micro-habitat, flock-size plasticity, movement behaviour, temporarily open temporarily closed, comparative method, critical ecologies, levels of associations.

1. Introduction

The purpose of this article is to compare and interpret the results of African Spoonbill *Platalea alba* presence during April 2015 with that of April 2016 at the West Kleinemonde Estuary and East Kleinemonde Estuary (33° 32'S, 27° 02'E and 33° 32'S, 27° 03'E) (Terörde 2008: 17, 19).

These two study sites (Fig.3) are in close proximity to each other in the immediate vicinity of the small town of Seafield (33° 32' 42'S, 27° 03' 05'E) along the R72-tarred road between Port Alfred and East London on the southeast coast of South Africa (Fig.2). For Stone *et al.* '[t]he Eastern Cape is largely a transition zone of climatic types' (Stone *et al.* in Lubke and de Moor 1998: 45) but more recently described as a warm, temperate biogeographic region (Whitfield and Baliwe 2013: 1). In 2008 the Present Ecological Status of the East Kleinemonde Estuary was rated as 87; the Estuarine Health Index was a high B, and generally classified as 'largely natural with few modifications' (Van Niekerk *et al.* 2008: iv). There is no evidence that suggests any different set of circumstances at the West Kleinemonde Estuary. The ecological condition of both estuaries has been described as 'fair' (Prinsloo 2012: 35). It has been reported that 'the bridge [on R72-road] does not appear to have had a major impact on the physical dynamics of the [East Kleinemonde] estuary' (Van Niekerk *et al.* 2008: 15). The West Kleinemonde Estuary functions under the same conditions. The two sections below the R72-road and the areas where both mouths open into the Indian Ocean (Fig.3) fall outside the study sites.

The fact that these two seemingly similar estuaries are next to one another (~350 m apart at the two study sites and even less downstream) make them ideal for comparative investigation. The West Kleinemonde Estuary is about 5 km long with a catchment area of 93,7 km² whilst the East Kleinemonde Estuary is 3,7 km long with a catchment area of 43,6 km² (Prinsloo 2012: 28-29; Vorwerk *et al*. 2003: 241). Their proximity makes them subject to the same rainfall events. Often they change their mouth status form temporarily open (TO) to temporarily closed (TC) at the same time which means that they are either open or closed in tandem (Fig.17). Water levels are similar since their berths are not noticeably different in height because they share the same sandbank (Fig.3). In addition, the ocean's impact on both are the same as both open to the sea often <100 m apart. In some instances the estuaries meet in the joint-berth area and then open as one mouth into the sea. As the water levels drop, the surface area of mudflats in both estuaries increases because they become more exposed. In such circumstances more than one newly exposed area appears in the form of 'independent islands' (Fig.11). Vegetation on the banks along the rivers (Fig.4, Fig.11 and Fig.13) is the same and has been described as 'undisturbed Valley Bushveld vegetation' (Prinsloo 2012: 28). The R72-road between Port Alfred and Seafield cuts across both estuaries at about 400 m upstream from the mouth opening area of each (Fig.3). Both estuaries are surrounded by residential housing – approximately '300 developed erven of which 200 are permanently occupied' (Turpie *et al.* 2008: 4) in the lower parts, and by cattle graze land further upstream. Some farms produce pineapples. Annual human impact on both study sites is the same, varying from recreational fishing, swimming, paddling, and the use of small motorized boats. Restricted water skiing (in demarcated areas) is infrequent except for the Easter and December holiday periods when Seafield's population increases substantially for a short period of three to four weeks. Both estuaries are also easily accessible for fieldwork.

Under these circumstances one would expect that intra-species behaviour of African Spoonbill would be similar. However, an array of factors negate this assumption: physical and chemical attributes of estuaries differ; configurations of biogeographic distribution of different estuarine habitats result in relative abundance, distribution and diversity of regimes such as saltmarshes, reeds or sedges that are characteristic of each. In addition, since '[a]nimal collective patterns such as group size frequency distributions [GSFD] often show substantial intraspecific variation, suggesting low species-specific consistency…' wrote Jovani *et al.* (2012: 397), a case is made that analyses of flock size frequency distribution (FSFD), would benefit from a number of previous GSFD-studies conducted by Jovani and co-researchers (Jovani *et al.* 2012; Jovani *et al.* 2007; Jovani *et al*. 2008a; Jovani *et al*. 2008b; Jovani *et al*. 2015).

The every-day language distinction between terminology such as population (an aggregate of…), group (e.g. nine different Spoonbill species of the world), community (number of birds roosting, nesting or breeding in communal space and time), flock (short-term gathering), and singletons (isolated, lone individuals) are sufficient for the purposes below. This investigation deals with the aggregate of African Spoonbills present at flock level as an autonomous analytical category.

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Figure 4. A flock (as an analytical category) of 12 African Spoonbills at the East Kleinemonde Estuary on 31 January 2016.

The following comparison shows the average daily presence of African Spoonbill at the study sites:

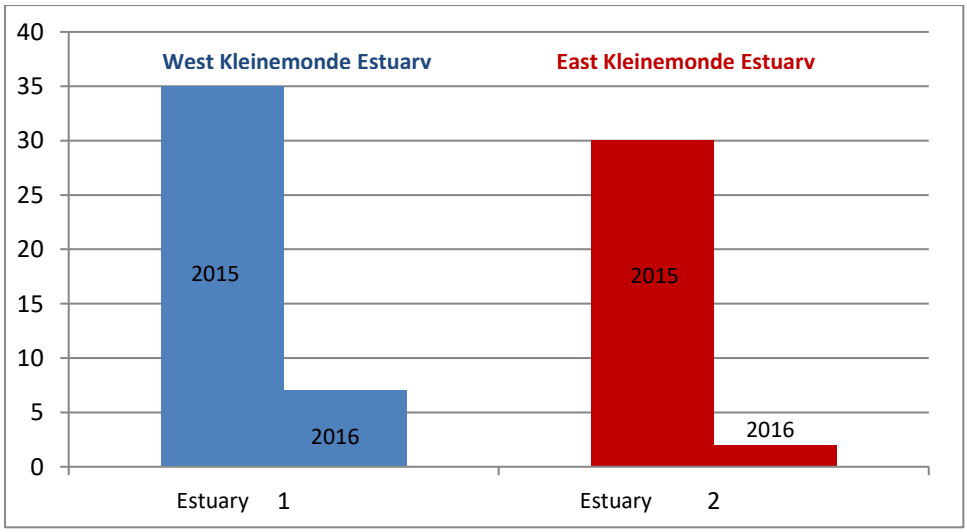

Figure 5. A comparison of the average number of African Spoonbills on days present for April 2015 and 2016 by estuary.

The total rainfall (Fig.16) in the immediate vicinity of the two estuaries for April 2015 was nine times more than in April 2016, or 151 mm *vs.* only 17 mm. These substantial rainfall

differences are compared to the monthly averages over a 12-year period in figure 9. It is commonplace in certain instances to accept the correlation between high rainfall events (Table 1) and specie's abundance (Table 1) during or shortly after high rainfall events (Terörde 2008: (i); Engelbrecht 2015a), as was the case in the first two days in April 2015.

A secondary aspect that will receive brief comment herein are the daily African Spoonbill counts for a further 13-month period, *viz.* from 1 May 2015 to 31 May 2016.

These two objectives is a temporally extended analysis of previous observations about African Spoonbill at five estuarine locations (Engelbrecht 2015a) in the same vicinity. This approach is at best, only a snapshot in the life-history of African Spoonbill that has been reported as being between nine and 14 years (Underhill *et al.* 1999: 35; Barnes in Hockey *et al*. 2005: 613). In order to overcome some of the limitations of this study the intension is that the combined results will in future form a data base for further study. The long-term plan is to continue the African Spoonbill counts so that it could shed light on a *longue durée* perspective regarding their presence at both estuaries. Such extended study should shed additional light on inter-month and -annual (Mondajem 2014: 52) population movement dynamics – at least over short distances at these two estuaries. More information about intra- and inter-flock behaviour will be forthcoming.

Although outside the cut-off date (31 May 2016) for the first objective of this study, on 9 May 2016, a flock of 13 African Spoonbill juveniles and a flock of 27 adults arrived six hours apart at the West Kleinemonde Estuary. Both flocks left within two days to go to the East Kleinemonde Estuary. Here, they continued to behave as two distinct groups. This kind of movement across to the East Kleinemonde Estuary goes to the heart of *a-priori* dispersal assumptions that need to be tested.

Since this seemingly once-off movement appears to be a similar inter-month movement between localities when compared to that of mid-April 2015 (Table 1 and Fig.22) at the West Kleinemonde Estuary, it implies that there is scope to study the relative longevity and frequency of immigrants and emigrants' movements in relation to the plasticity (the ability of organisms of the same genotype to vary in patters of development or in behaviour in relation to different environmental conditions) of foraging niche size and the size of populations, groups, communities and flocks. On the one hand it raises questions about the possible transient use of micro-habitats by special generalists, but on the other, if there can be any question about site faithfulness under circumstance of severe preferred biome fragmentation. Not only do flock sizes vary daily, but the frequency of flock size plasticity in relation to other thresholds, are dissimilar and are presented as follows:

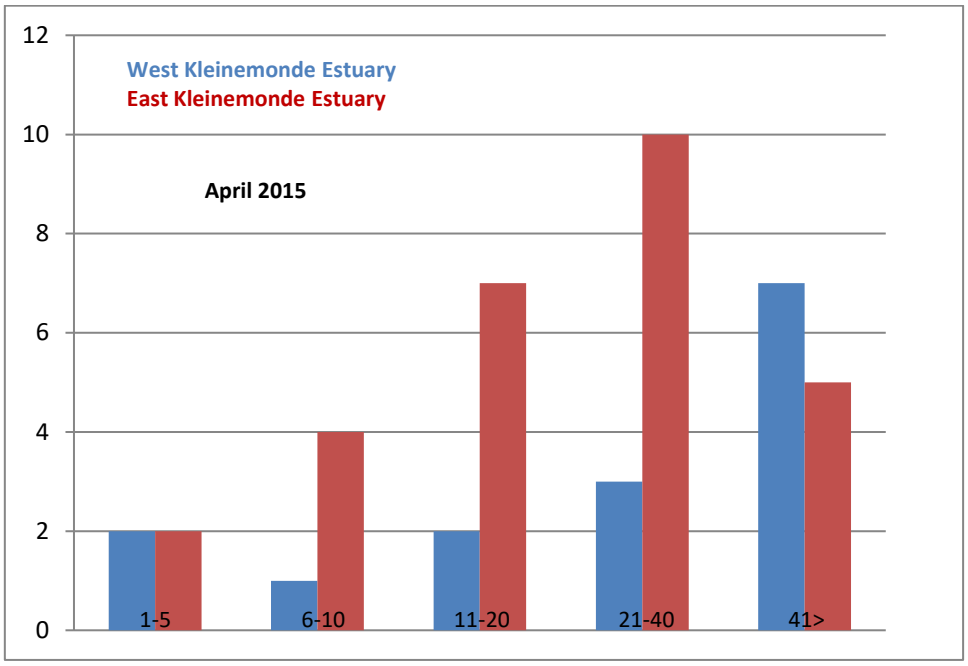

Figure 6. Frequency of flock size plasticity for five thresholds during April 2015 at the study sites.

The frequency of flock size at the East Kleinemonde Estuary in April 2015 (Fig.6), were across three of the five thresholds, greater than that of the West Kleinemonde Estuary. In April 2016 (Fig.7), the situation was different when there were no flocks recorded for the month, whilst the West Kleinemonde Estuary had only seven incidents of flocks during the last week – it varied between seven and 13 in size.

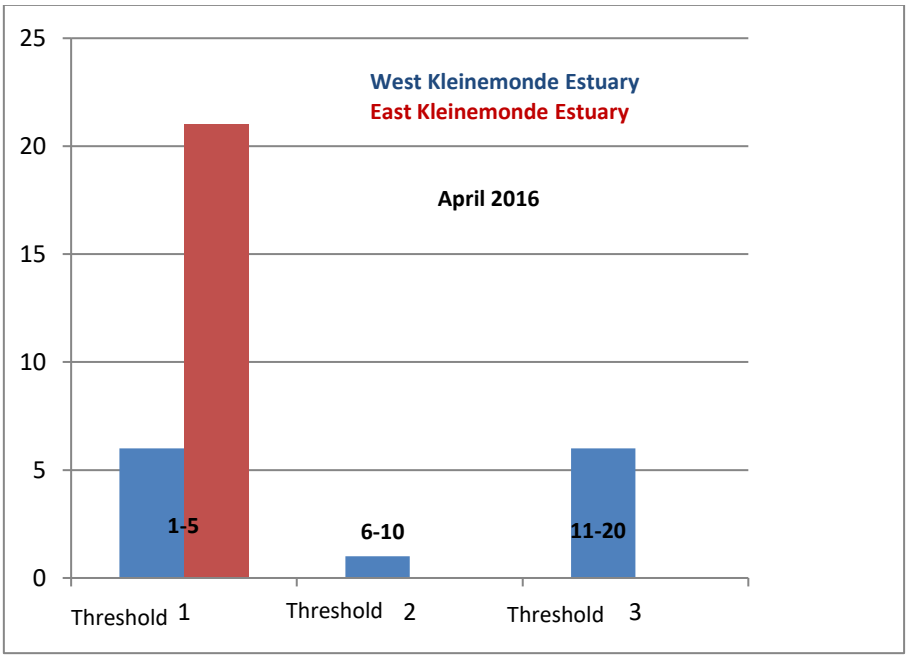

Figure 7. Frequency of flock plasticity for three thresholds during April 2016 at the study sites.

Estuarine mouth status (Fig.17) classified as either temporarily open (TO) or temporarily closed (TC), is included because of its interrelatedness to rainfall (Fig.9, Fig.10, Fig.15 and Fig.16). No consideration was given to the age structure of African Spoonbills as it manifests in the composition and dynamics of the pre-reproductive, reproductive and post-reproductive stages of the life-history of African Spoonbills.

2. Two climatic indicators for Seafield

A few observations about temperature and rainfall will suffice. It is discussed in detail in section 4 below.

There is no data to suggest that the average monthly high/low temperature for Seafield in April 2016 was significantly different from the averages over 12-year period (Fig.8).

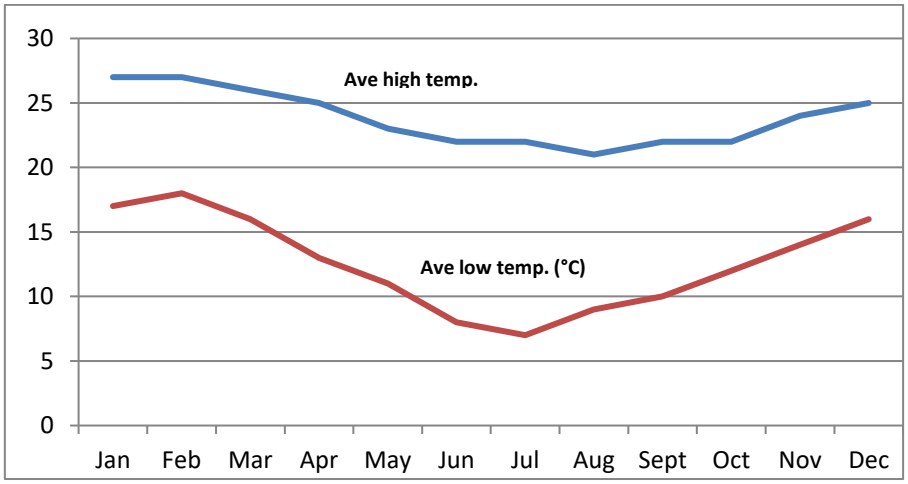

Figure 8. Average monthly (from year 2000 to 2012) high/low temperature (°C) for Seafield, South Africa

Source: http://developer.worldweatheronline.com/.

This was not the case regarding rainfall. The average monthly rainfall (mm) and average number of rainfall days over a 12-year period for Seafield are presented in the following graph.

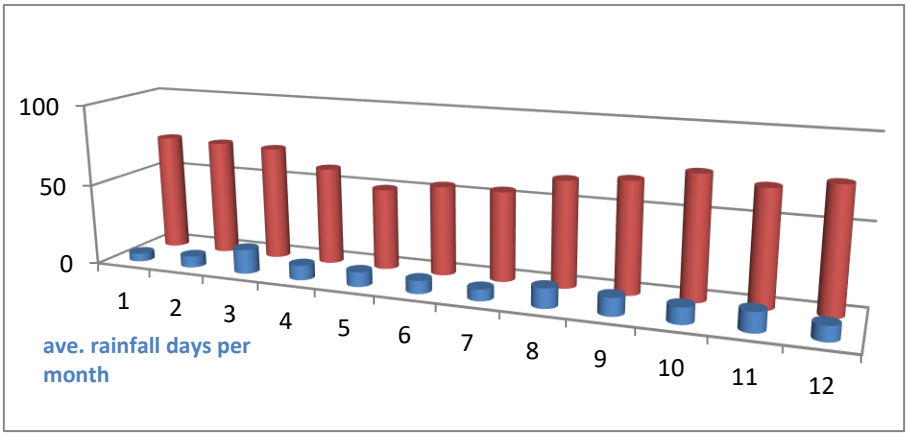

Figure 9. Average monthly rainfall (mm) (red), and average number of rainfall days (blue) for Seafield from 2000 to 2012. **Source:** http://developer.worldweatheronline.com/.

The number of rainfall days for March 2015 and 2016 and that of April 2015 and 2016 (Fig.10) are very different from the 12-year monthly averages represented (in red) in figure 9. The average number of rainfall days (in blue) for March and April over a 12-year period (Fig.9), was about double the number of rainfall days recorded for March 2015 (3 days) and April 2015 (5 days) as well as the two days for March 2016 and two days for April 2016. These differences in rainfall events are major factors influencing African Spoonbill movements at the study sites because they are so reliant on micro-habitats.

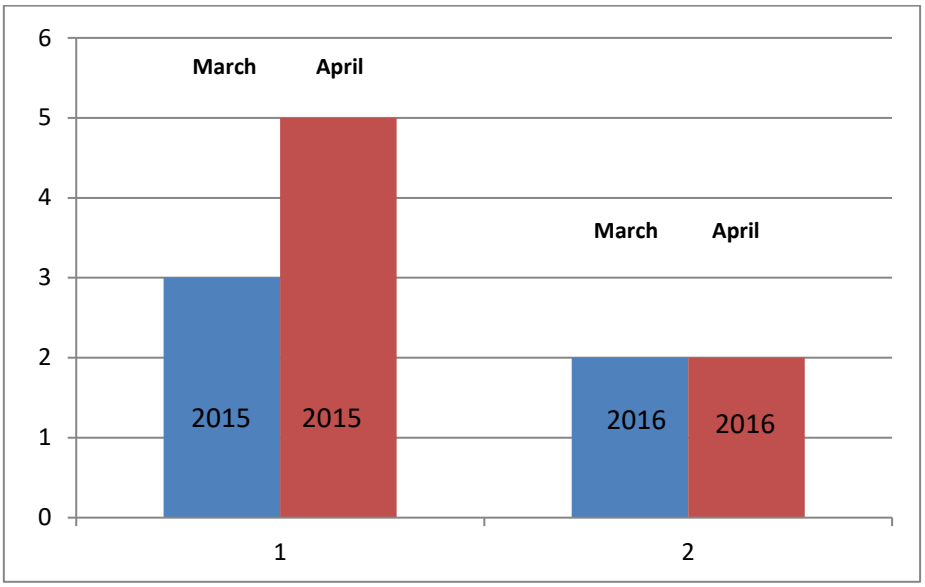

Figure 10. Number of rainfall days compared between two months and two years.

3. Methodology

The comparative method of sciences is deeply imbedded in ornithology: scientists and non-scientists compare basically every aspect of their field of interest spanning many disciplines. In fact, the comparative method is a minimum condition for understanding phenomena under investigation. This study is no different.

The photos (Fig.3, Fig.4, and Fig.11–14) of the two study sites assist to give realistic impressions of both.

Figure 11. Kleinemonde Estuary in TC status.

Figure 12. East Kleinemonde Estuary in TO status. C Engelbrecht

Figure 13. West Kleinemonde Estuary count site in TC status. C Engelbrecht

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Figure 14. West Kleinemonde Estuary in TO status immediately after excessive rains on the first two days of April 2015.

Two observation points for each estuary were identified to conduct the point method of counts. The second was used to confirm the counts of the first when there was uncertainty about the accuracy of the first count. Only when the results corresponded was the confirmed result recorded. The daily counts took place between 7:00 and 8:00 over a period of 13 months (from 1 April 2015 to 31 May 2016). There were only 14 no-count days. They do not form part of the immediate research objectives and had no bearing on the data collected for comparing April 2015 to April 2016. The count days for April 2015 and 2016 were recorded in Table 1.

To observe the mouth status of both estuaries as either temporarily open (TO) or temporarily closed (TC), daily visits were made on the same mornings after the daily counts were concluded. The mouth status was recorded on the same count sheet as either TO or TC. Overtopping was excluded.

The following equipment was used: 10 x 50 binoculars; 20-60 x 90 spotting scope; camera tripod, and a monopod. Photos were taken with a DSLR camera and 170-500 mm lens.

Table 1. Results of 30 counts of African Spoonbills at the study sites from 1 April 2015 to 30 April 2015.

2015	2015	2015	2016	2016
Count date	**West Kleinemonde Estuary count**	**East Kleinemonde Estuary count**	**West Kleinemonde Estuary count**	**East Kleinemonde Estuary count**
1/4	5	4	0	0
2/4	14	11	2	1
3/4	23	17	2	1
4/4	27	23	2	1
5/4	38	34	2	1
6/4	47	40	0	2
7/4	53	4	0	1
8/4	52	11	0	0
9/4	**49**	**14**	0	1
10/4	**57**	**7**	0	2
11/4	**68**	**8**	0	1
12/4	**4**	**82**	0	2
13/4	**62**	**7**	0	1
14/4	**7**	**66**	0	2
15/4	**0**	**82**	0	2
16/4	**0**	**93**	0	1
17/4	**0**	**33**	0	1
18/4	0	32	1	2
19/4	0	13	1	0
20/4	0	8	0	2
21/4	0	31	0	0
22/4	0	35	0	3
23/4	0	28	0	0
24/4	0	43	13	0
25/4	0	38	11	2
26/4	0	32	14	0
27/4	**18**	**28**	13	0
28/4	0	18	11	0
29/4	0	17	12	2
30/4	0	0	7	4
Total count for month	524	859	91	35
No of days	15	29	13	21

present in month				
% of month present	50	96,6	43,3	70
Ave No present for days present of month	35	30	7	2

4. Discussion

4.1 Rainfall comparison between March 2015 and March 2016

This section merely serves as background to indicate the immediate rainfall status for the month before the start-date of this study.

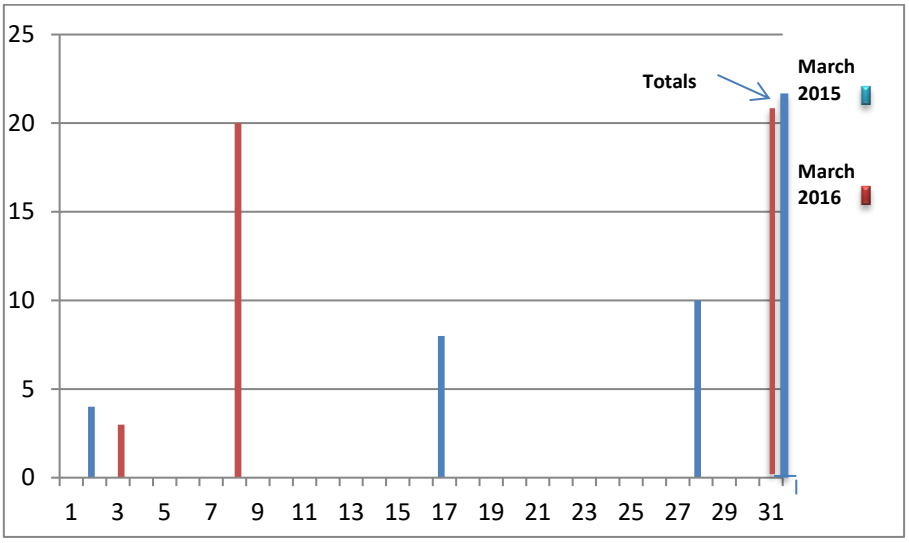

Figure 15. Rainfall (mm) comparison between March 2015 and March 2016.

No heavy rainfall took place in March that could have prompted African Spoonbills to visit the two study sites. In fact, the total rainfall (22 mm) for March 2015 fell on two days, but 23 mm in March 2016 on three days, making these rainfall events almost the same (Fig.10 and Fig.15). The average rainfall per rainfall day was also dissimilar: 7,4 mm per rainfall day in March 2015 was appreciably less than 11,5 mm for March 2016. Four millimetres (or 18,1% of the total month's rain) fell in the first half of the month; the remainder (18 mm or 81,8%) in the second half of March 2015. March 2016 was similar: 3 mm (or 13%) fell in die first half of the month and the rest (20 mm or 86%) in the second half of the month.

There is a noticeable difference: close to April 2015, 10 mm rain fell on 28 March 2015, shortly before the estuaries broke open a few days later on 2 April 2015. This did not happen in 2016 because no rain fell in the second half of March (Table 1). The 10 mm rain in late-March 2015 made the likelihood for mouth breach greater when compared to April 2016

when no rainfall events occurred. In this instance more than 100 mm rain was required in relative short time for the mouths to breach. It has been reported that '[b]ased on a water surface area of c. 35 ha the [East Kleinemonde Estuary] estuary would require between 300 000 m^3 and 600 000 m^3 of water to initiate a breach' (Whitfield *et al.* 2008: 454).

4.2 Rainfall comparison between April 2015 and April 2016

The similar total rainfall for March 2015 and 2016 (Fig.15) differed from that of April 2015 and 2016:

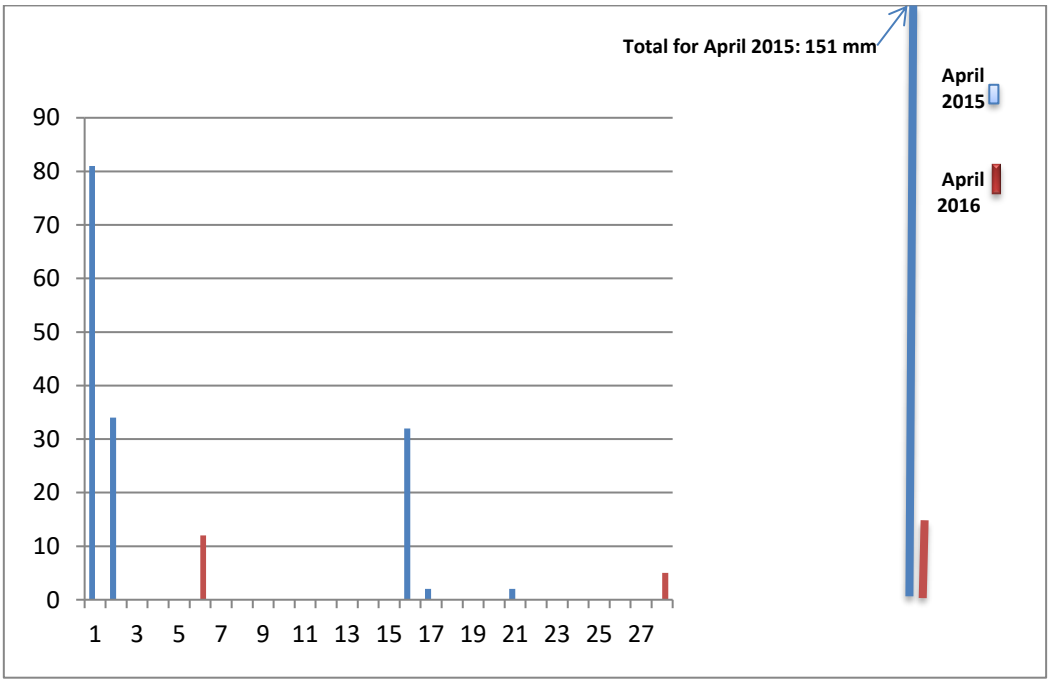

Figure 16. Rainfall (mm) comparison between April 2015 and April 2016.

The obvious difference in the totals is that in April 2016 a total of only 17 mm were recorded *vs* a total of 151 mm for April 2015. Thus: the total rainfall for April 2016 about nine times less in comparison to the previous year. Secondly, April 2015 had a total of five rainfall days whereas April 2016 had only two. This is not too dissimilar to March 2015 – three rainfall days, but only two for March 2016. The average rainfall per rainfall day is 30,2 mm for April 2015 but only 8,5 mm for April 2016 (or 3,5 times less in April 2016).

Furthermore, two (40%) of the five rainfall days of April 2015 fell in the first half of the month. The total rainfall for those two days alone was 115 mm (75%) of the month's total. The remainder, 36 mm (25%) fell in the second part of April 2015. Again, this is very different from April 2016: in the first week of April 2016, only 12 mm were recorded on one day, and

the last week 5 mm on a single day. In other words, in April 2016, 75% of the total month's rain fell on one rainfall day early in the month, and 25% on the second rainfall day in the last week of the month as indicated in Section 4.1. These made the likelihood for estuary mouth breaks in April 2016 unlikely when compared to April 2015.

4.3 Estuarine mouth status comparison between April 2015 and April 2016

A detailed explanation of estuarine mouth dynamics is unnecessary because it has previously been studied (Van Niekerk *et al*. 2008). However, the following general observations will suffice.

Estuarine mouth status is influenced by tidal activity that is the result of ocean wave dynamics, currents, wind, etc. Secondly, the characteristics of a berm make it difficult or easy for waves to impact on the mouth as well as for the estuary's water regime to overflow and scour a trough through the berm which then lets the accumulated upstream water out to sea. Thirdly, wind blowing across the mouth deposits sand between the sea and the estuarine water regime, thus making the berm higher, or lower, when sand is blown away. Lastly, the impact of the volume of the estuarine water regime that forces water outflow downstream depends on the volume of water coming in from the catchment area, the speed (velocity) at which is flows towards the sea, the berm conditions, and the wind blowing down the estuary towards the mouth. It appears that the tidal activity and volume of water inflow are the two dominant factors influencing mouth status. The longer the periods between open and closed conditions, the higher the berm. All these factors work in unison to result in either TO or TC condition. Professor P. Cowley's estuarine mouth observations for the period 1993 to 2002 concluded that 'breachings [at the East Kleinemonde Estuary] occurred in 2–3 months of the year on average' (Van Niekerk *et al*. 2008: 5). The mouth status for both estuaries in terms of either TO or TC is represented as follows:

A5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

Figure 17. Mouth status for April 2015 (A5) vs April 2016 (A6)

Key: Red = TC and Green = TO.

At the end of March 2015 and 2016, both estuaries were in TC status. But, during the early hours of 2 April 2015, both estuaries breached their berms to enter into TO status and remained open until 29 April 2015. This was because on two days (1 April and 2 April 2015) 115 mm rain fell in the immediate vicinity of both estuaries. The water levels in both rose by at least one meter – enough for the estuaries to breach their berms. Within 12 hours, a new

channel was scoured deep in the mouth area of each estuary for the water levels to have dropped by about 80 cm below their pre-flood levels – that is, before it started raining on 1 April 2015. The water levels for the rest of the month remained low because of the TO condition at both estuaries. Despite the further 36 mm rain in the second half of the month, the mouth status for both remained closed (for the next 13 months) at the time of writing (June 2016).

The situation for April 2016 was different (Fig.16). With two rain days (on 6 April and 30 April 2016) and a rainfall totalling only 17 mm, it was not nearly enough to have had any meaningful impact on the water levels of both estuaries. This highlights the importance of high volume incoming water from the catchment required as a necessary condition to cause TO events as happened in in April 2015. Without abnormal water volumes in a relatively short space of time, tidal activity, wind and waves alone, could not cause TO conditions in both estuaries. These events impact on African Spoonbill abundance since they "undertake nomadic movements in response to changing water-levels" (Underhill *et al.* 1999: 35; Engelbrecht 2015a).

5. Average number of African Spoonbills per day present for April 2015 and 2016

Throughout this study the value of the comparative method is that it highlights similarities and differences. After substantial rains (115 mm) were recorded in only two days at the beginning of April 2015, the combined total African Spoonbill counts for the month at the two estuaries were 1 383 *vs* 126 for April 2016 (Fig.19). This made the total rainfall for April 2015 almost 11 times more than in April 2016 when only 17 mm was recorded (Table 1 and Fig.16). Noteworthy is that in April 2015 there were on average 35 birds present for 50% (15 days) of the month at the West Kleinemonde Estuary, but at the East Kleinemonde Estuary, 30 were on average present for 96,6% (29 days) of the month (Fig.18).

The following year (April 2016) the situation was different. At the West Kleinemonde Estuary, only seven African Spoonbills were on average present on 13 days (or 43,3%) of the month. In contrast, at the East Kleinemonde Estuary two were on average present on 21 days (or 70%) in April (Table 1 and Fig.18).

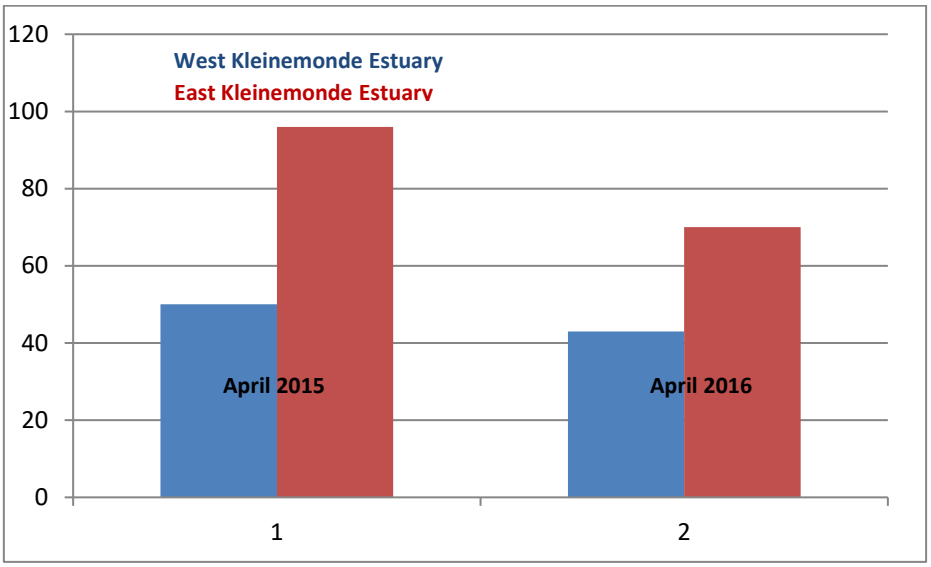

Figure 18. Percentage of the month when African Spoonbills were present by year and estuary.

Furthermore, the East Kleinemonde Estuary's 859 African Spoonbills counted for April 2015, were 38,9% more than the 524 of the West Kleinemonde Estuary for the same month. The total number of African Spoonbills counted for April 2015, was about 11 times more than the 126 for April 2016 (Fig.19). This suggests that many African Spoonbills at the West Kleinemonde Estuary went across to the East Kleinemonde Estuary in the middle of April 2015 (Table 1, Fig.20 and Fig.22).

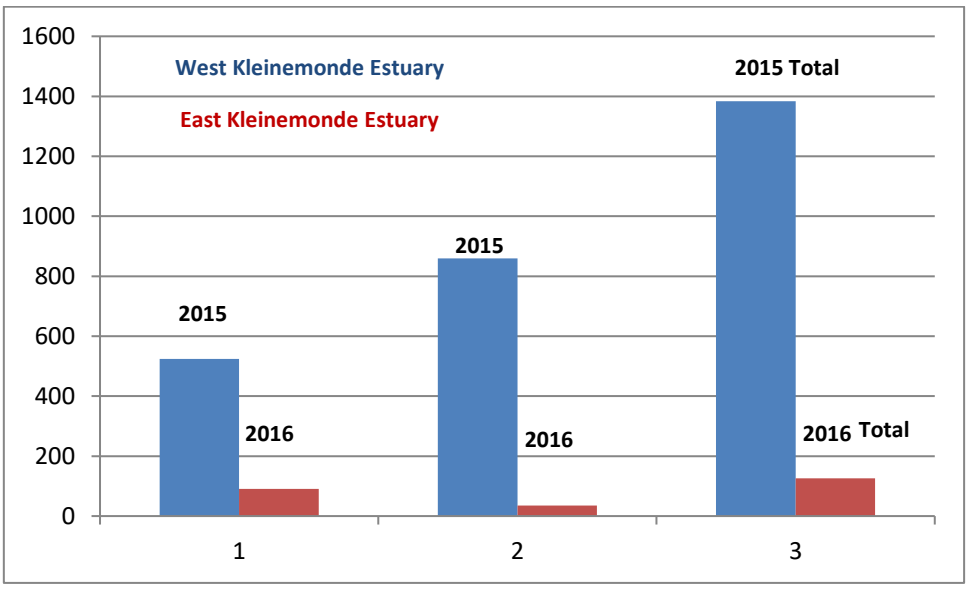

Figure 19. Total counts per estuary per month for April 2015 and 2016.

Figure 20 compares the daily counts for April 2015 for both estuaries and figure 21 for April 2016:

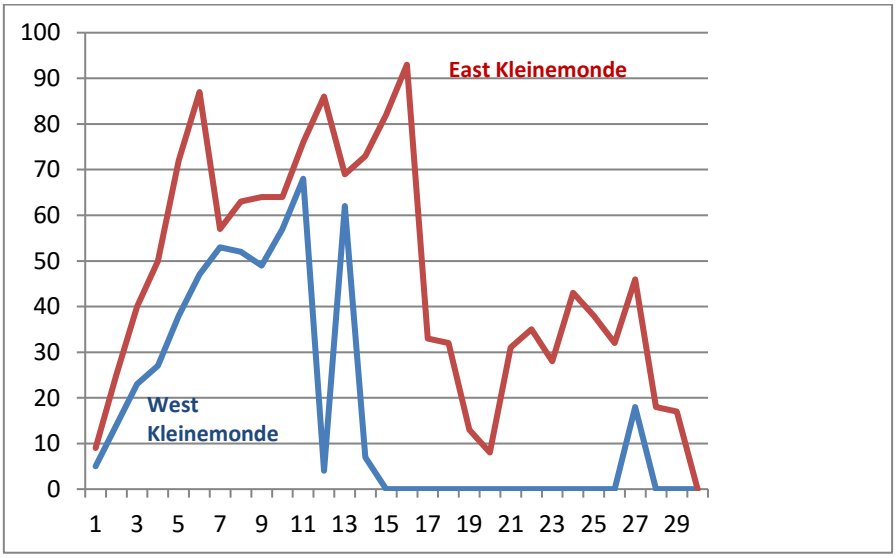

Figure 20. Comparison of African Spoonbill daily counts at West and East Kleinemonde estuaries for April 2015.

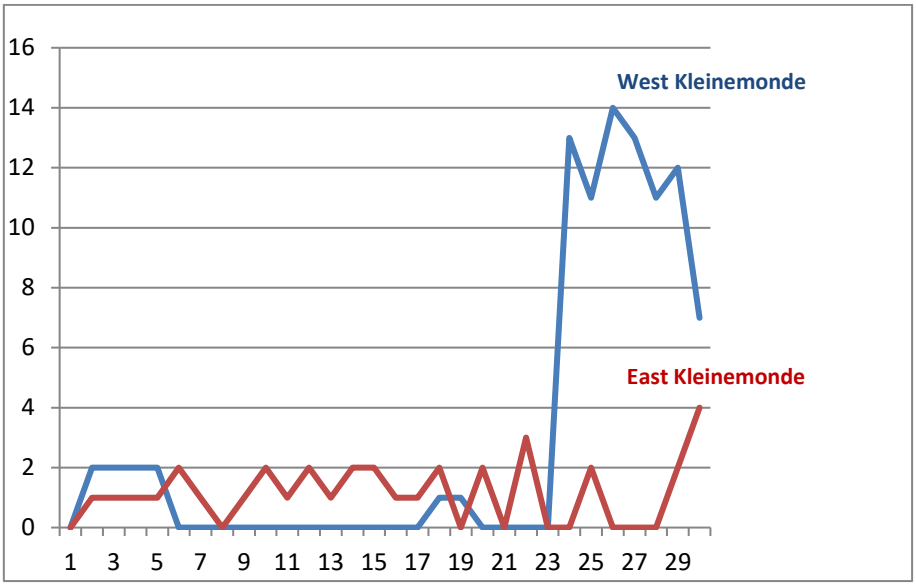

Figure 21. Comparison of African Spoonbill daily counts at West and East Kleinemonde estuaries for April 2016.

The comparisons are interpreted as follows: Firstly, (as mentioned above) April 2015 had 524 counts at the West Kleinemonde Estuary but 859 at the East Kleinemonde Estuary (Table 1, Fig.19 and Fig.20) suggesting that many birds emigrated to the East Kleinemonde Estuary from 12 April to 16 April 2015 (Table 1 and Fig.22).

Secondly, April 2016 saw 93 counts at the West Kleinemonde Estuary but only 35 at the East Kleinemonde Estuary (Table 1 and Fig.19). Whilst the East Kleinemonde's count in April 2015 was much higher than that of the West Kleinemonde Estuary, the situation was reversed in April 2016 (Table 1 and Fig.19) when the West Kleinemonde Estuary's count was three times more than that of the East Kleinemonde Estuary. Table 1 confirms that there were not nearly sufficient African Spoonbills present in April 2016 at the East Kleinemonde Estuary to have "fed" the West Kleinemonde Estuary. Also, unlike in April 2015, there were no migratory movements in April 2016 between the two estuaries. Even during the last week of April 2016 when on average 11 African Spoonbills were present per day for that week at the West Kleinemonde Estuary, they did not emigrate. In other words, unlike in April 2015, there is no supporting evidence from the counts to suggest any emigrated in April 2016.

Thirdly, on 1 April 2015, five African Spoonbills arrived at the West Kleinemonde Estuary and four at the East Kleinemonde Estuary (Table 1) in practically equal numbers. This was shortly after 10 mm rain fell in the immediate vicinity of both estuaries on 28 March 2015. However, no rains fell during the same time in the immediate vicinity of both estuaries in 2016 and no Spoonbills were present at both estuaries at the time. This changed within hours after 81 mm rain fell on 1 April 2015 and 34 mm the next day. No rain fell in the immediate vicinity of both estuaries in April 2016. African Spoonbill abundance immediately increased to 14 on 2 April 2015 at the West Kleinemonde Estuary and 11 at the East Kleinemonde Estuary (Table 1). In contrast with no rain in April 2016, on 2 April 2016, three African Spoonbills were counted: two at the West Kleinemonde Estuary and one at the East Kleinemonde Estuary.

Fourthly, from 2 April to 11 April 2015 (thus for 10 days) African Spoonbill numbers further increased from 14 to an all-time high of 68 on 11 April 2015 in the West Kleinemonde Estuary. In the East Kleinemonde Estuary the situation was again different: from 2 April to 6 April 2015 (thus in five days only), the African Spoonbill numbers increased daily from 11 to only 40. The all-time high of 93 was recorded as late as 16 April. In comparison, during April 2016, the situation remained practically unchanged varying between 2 African Spoonbills per day from 2 April to 5 April and then nil to 17 April 2016, thereafter only one and one African Spoonbills for 18 and 19 April and again nil to 23 April 2016 for the West Kleinemonde Estuary. But at the East Kleinemonde Estuary, April 2016 saw either nil or two African Spoonbills per day with the exception of three on 22 April or four on 30 April.

In the fifth instance, major changes started on 12 April 2015 at both estuaries making the second half of the month very different. Table 1 and figure 22 show how African Spoonbill inter-site movements took place from then onwards away (emigration) from the West Kleinemonde Estuary to (immigration) the East Kleinemonde Estuary. For example: of the 68 African Spoonbills that were present on 11 April 2015 at the West Kleinemonde Estuary,

only four were left the following day (12 April 2015), whilst the East Kleinemonde Estuary, the eight African Spoonbills on 11 April 2015 have increased to 82 on 12 April 2015. The next day (13 April) the Spoonbill numbers were again up to 62 at the West Kleinemonde Estuary but then down from 82 on 12 April 2015, to seven on 13 April 2015. A day later (14 April) the situation was reversed: the West Kleinemonde Estuary had seven and the East Kleinemonde Estuary had 66 African Spoonbills. For the next two days (15 and 16 April) the East Kleinemonde's number rose to 82 and 93 respectively, whilst the West Kleinemonde's numbers remained at nil until 18 arrived on 27 April (for this one day only) and then remained nil for the next few days until 30 April 2015 (which was also the last day of the counts for the purpose of this study). These transient-type of immigration and emigration movements can be shown as follows:

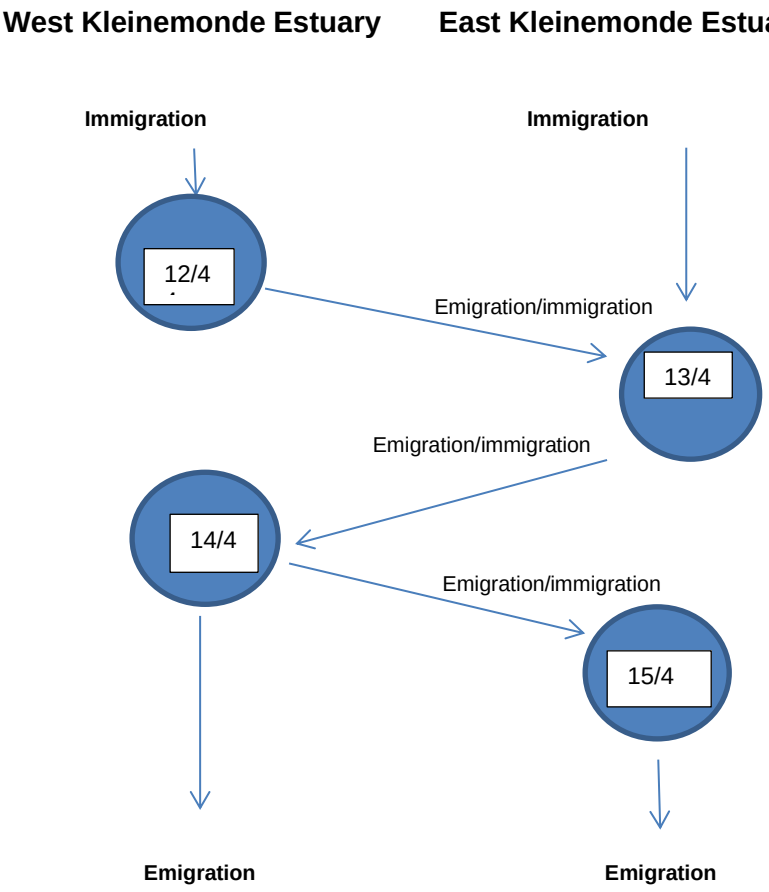

Figure 22. Three to-and-fro (immigration/emigration) movements by African Spoonbills (April 2015) between two estuaries.

The numbers increased in the first half of April 2015 to 403 counts at the West Kleinemonde Estuary and 389 counts for the East Kleinemonde Estuary by 15 April 2015. From then on, all the Spoonbills at the West Kleinemonde Estuary moved emigrated to the East Kleinemonde Estuary (nine on one day), increasing the highest daily count up to 93 African

Spoonbills on 16 April 2015. From the highest count of 93 on 16 April 2015 at the East Kleinemonde Estuary, the numbers then declined on almost a daily basis to nil on 30 April 2015. It is interesting to note that with the exception of one day (27 April 2015), the West Kleinemonde Estuary had no more African Spoonbills for the entire second half of April 2015. The next year this changed when, in the second half of April 2016, a total of 83 individuals were counted at the West Kleinemonde Estuary. In other words they did not frequent the West Kleinemonde Estuary in the second part of April 2015 but a year later they did. Only this time (second half of April 2016), they seem to have had no interest to move across to the East Kleinemonde Estuary as they did the previous year. These daily inter-site immigration and emigration between the two estuaries by African Spoonbills for April 2015 are presented as follows:

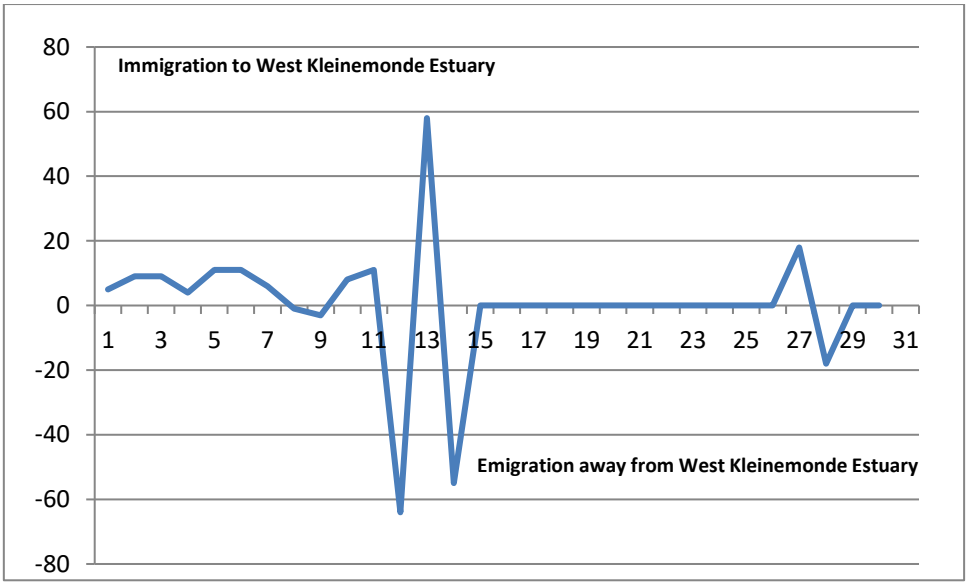

Figure 23. Spoonbill immigration and emigration at the West Kleinemonde Estuary in April 2015.

When comparing figure 23 to figure 25, the West Kleinemonde Estuary's in April 2015 is almost the reverse of that in April 2016.

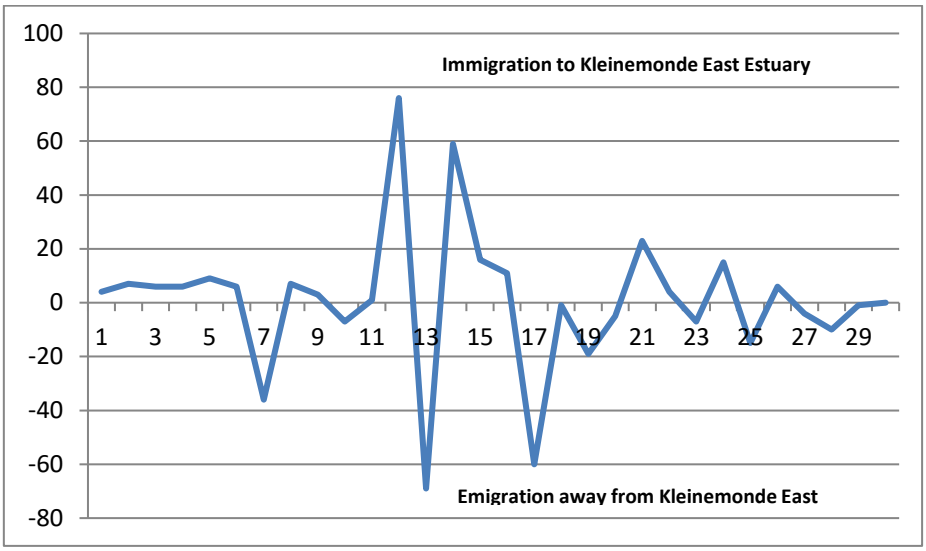

Figure 24. Spoonbill immigration and emigration at the East Kleinemonde Estuary in April 2015.

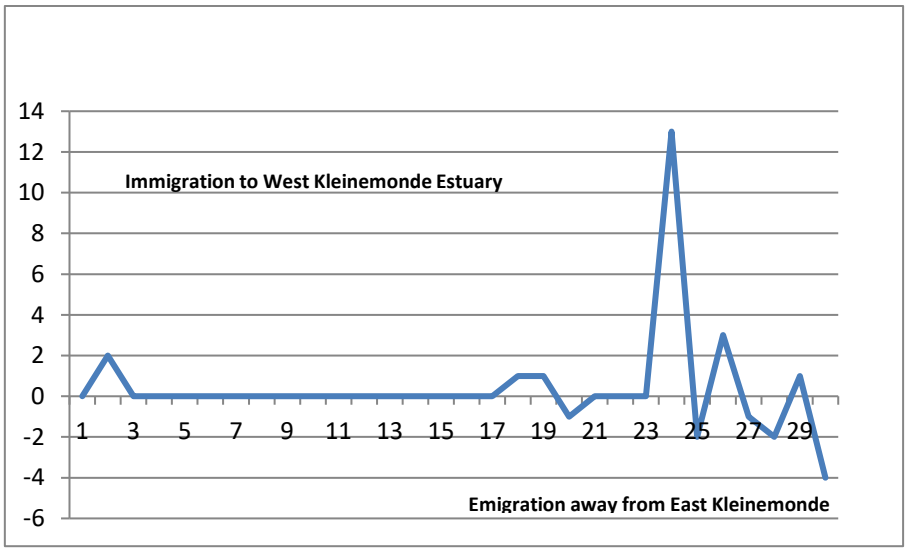

Figure 25. Spoonbill immigration and emigration at the West Kleinemonde Estuary in April 2016.

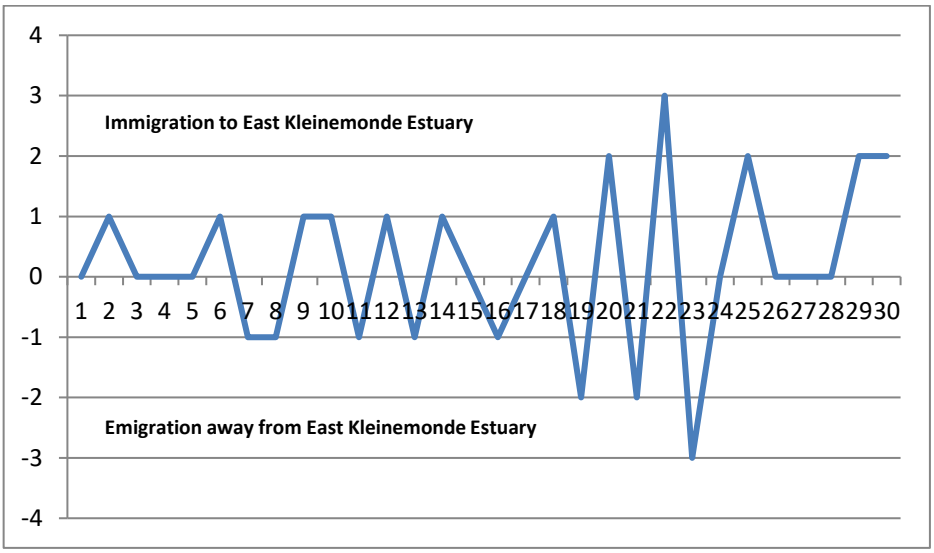
4
3
2
1
0
-1
-2
-3
-4
Immigration to East Kleinemonde Estuary
Emigration away from East Kleinemonde Estuary
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Figure 26. Spoonbill immigration and emigration at the East Kleinemonde Estuary in April 2016.

At the West Kleinemonde Estuary, most immigration took place in the first half of April 2015 (Fig.23) with only one day's 18 in the latter part of the month (Table 1). Immigration took place on 11 days (36,6%) of the month: emigration took place on five (16,6%) of the month. This suggests that arrivals to the estuary were slower than departures. Emigration only started in week two (from 8 April). For seven days (or 23%) of the month were there no emigration. At the East Kleinemonde Estuary, immigration took place on 16 days (53,3%) of the month spread over the entire month, whilst emigration took place on 12 (40%) of the month.

The situation in April 2016 was different. The West Kleinemonde Estuary had only three immigration days (10% of the month) during the first week, but emigration on six (20% of the month) in die last week. Essentially, African Spoonbills arrived twice that month – in the first week end left, and again in the last week and left. The East Kleinemonde Estuary had 11 immigration days (36,6%) of the month and nine (30%) emigration days. This is insignificant since it was mostly singletons (one or two) moving in and out except for one day when three arrived and left and four on the last day of the month. Thus in April 2016 flock-size presence at the West Kleinemonde Estuary was only during the last week but no flock-size numbers were recorded at the East Kleinemonde Estuary for the entire month.

6. Flock size frequency distribution (FSFD) at the study sites

Animal collective behaviour makes group size or flock size, pivotal in various kinds of animal social interactions (Jovani *et al.* 2012: 397). A flock of birds is a varying number of birds, conducting a specific congregating behaviour, e.g. during (but not exclusively) flight or foraging. The application of FSFD assists in understanding how the worlds of birds are

constituted, perceived and possibly be tested. This term takes after the phenomenon of group size frequency distribution (GSFD) that Jovani and co-workers studied (Jovani *et al.* 2007; Jovani *et al*. 2008a; Jovani *et al*. 2008b; Jovani *et al*. 2012; Jovani *et al*. 2015). A few points about the different ways of worldmaking (Goodman 1978; 7-17) are worth considering.

African Spoonbills make their worlds by effecting changes between flocks. It is a phenomenon of give and take. This inter-flock movement means that flock size is not consistent because it expands and contracts in time through the processes of immigration and emigration. Table 1 clearly shows how flock size plasticity can change very quickly – or rather slowly through the same set of behaviours. For this reason they are temporally diverse events in space and place where the new flock is reconstituted in another way.

Similarly, emigration leaves a changed situation behind. Such supplementation (immigration) and dwindling (emigration) between old and new differ in response to the practical needs of African Spoonbill for specific purposes. The literature about the rationale for the formations of flocks as a particular manifestation of group behaviour, points at the primary considerations such as: safety in numbers, or the cost-benefits in flying or foraging together. For instance, safety in numbers in flocks might mean less time having to be on the lookout for predators and therefore potentially resulting in more time for foraging – or for any of the other three activities being: resting (sleeping, standing, sunning, lying down); orientation (flying or swimming between areas), or maintenance (preening, nest-building, mating, territorial behaviour) as categorized by Terörde (2008: 29). A species-specific investigation would be productive to determine the relative time spent on each activity. This is of particular interest given the African Spoonbill view that they ‘use the estuary [East Kleinemonde Estuary] mainly for feeding and roosting, but breed elsewhere’ (Whitfield *et al.* 2008: 454). In a study about feeding ecology and activity patters of African Spoonbill at Lake Ziway in Ethiopia, the researchers found that African Spoonbill spent 23,3% of their time on feeding (Mojes and Balakrishan 2014: 169).

The newly created orderings (of flocks either staying behind or new ones that were formed) change with varying circumstances and objectives. Such plasticity of flocks is evident in the daily counts recorded in Table 1 and represented in figures 6 and 7. A major shortcoming in this study is the lack of information that would explain where African Spoonbills that frequent the study area immigrate from and where they emigrate to. This would also shed light on the correlation between flock size and foraging range (Jovani 2015: EV5) but would not necessarily explain causalities of such open communities. But, previous research findings about ringing discoveries (Underhill *et al.*1999: 35) confirm nomadic movements of two ringed African Spoonbills that covered distances >1 000 km in South Africa. In fact, these ringing results suggest that that African Spoonbill had no interest in the

study sites under investigation. For instance, on 4 April 2015 when the count was 27 at the West Kleinemonde Estuary, the 27 African Spoonbills were a gain of four on the previous day. It is most unlikely that these four came from the East Kleinemonde Estuary since the numbers there were gradually increasing to 40, at least until 6 April without any sign of emigration loss. This suggests that flocks somewhere else lost members, or distant flock spilt up to be divided between the two estuaries. Similarly, the 60 that left the East Kleinemonde estuary on 16 April, leaving about 33 behind, must have gone somewhere else establishing themselves as a new flock, or they split into different sub-flocks changing the plasticity at a number of other locations where ty arrived. In other instances, primarily through the entire April 2016 at the East Kleinemonde Estuary, the movement behaviour were that of singletons – one or two that moved to or away. Table 1 confirms that for a large part of April 2016, they did not frequent the West Kleinemonde Estuary.

This example points at a number of characteristics of a flock as an analytical category. Figure 27 indicates the various relationships between relative flock numbers. Level I suggest that one individual joins another one, a pair, a partial flock or a full flock. Level II proposes that a pair makes its connections with one, another pair, a partial flock or full flock somewhere else. The same holds true for Levels III and IV. One, a pair, a partial flock or full flock that arrive to join any of the Levels I-IV, are considered emigrant/s from where they left but are immigrant/s where they join to form a new association. In both instances (leaving or arriving) their termination of old or forming of new relationships either decreased or increased the numbers of new or previous association/s. In extreme circumstances, extinction of old or formation of new, results. The ultimate level of gain is the flock; the ultimate loss is the extinction of a flock. Thus: plasticity of flock-size frequency distribution results in compacting and de-compacting of relative congregational size/s e.g. into flocks. In instances, the existence of one (an individual) or a flock are necessary conditions in bird (African Spoonbill) interactions for survival. These associations, as explained above, are presented as follows:

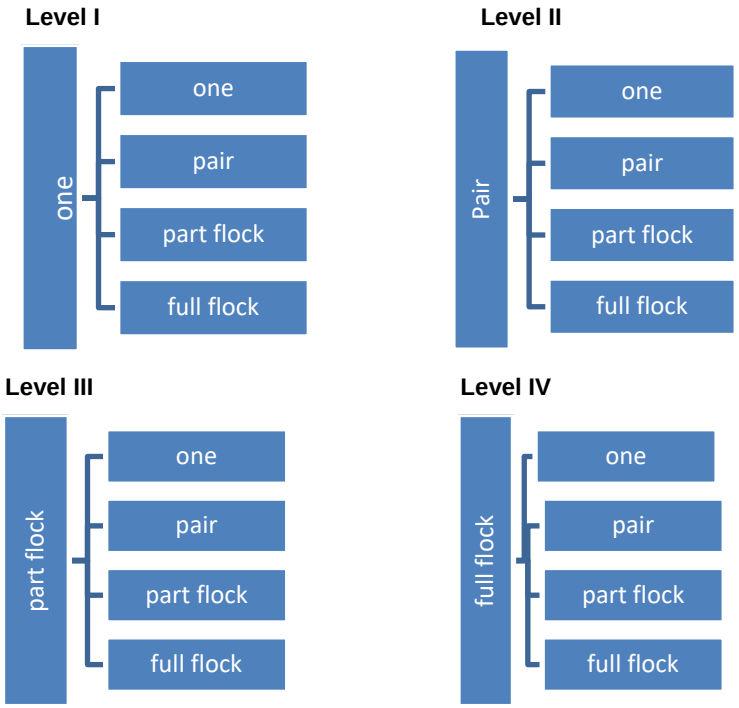

Figure 27. Four levels of associations in the process of flock forming.

One of the outstanding differences in the intra-specie collective behaviour of African Spoonbills between 2015 and 2016 at the two study sites, is that of flock sizes and frequency in 2015 *vs* the high percentage of singletons in 2016 (Table 1 and Fig.6). The frequency of no-flock days (Fig.28) as a percentage of the month shows noticeable differences. In April 2015 the West Kleinemonde Estuary had no-flock days for 50% of the month; the East Kleinemonde Estuary had no-flocks for only 3,3% of the month. The following year, West Kleinemonde Estuary had no flocks for 76,6% of the month and the East Kleinemonde Estuary had no flocks at all for the entire month. The comparisons are illustrated as follows:

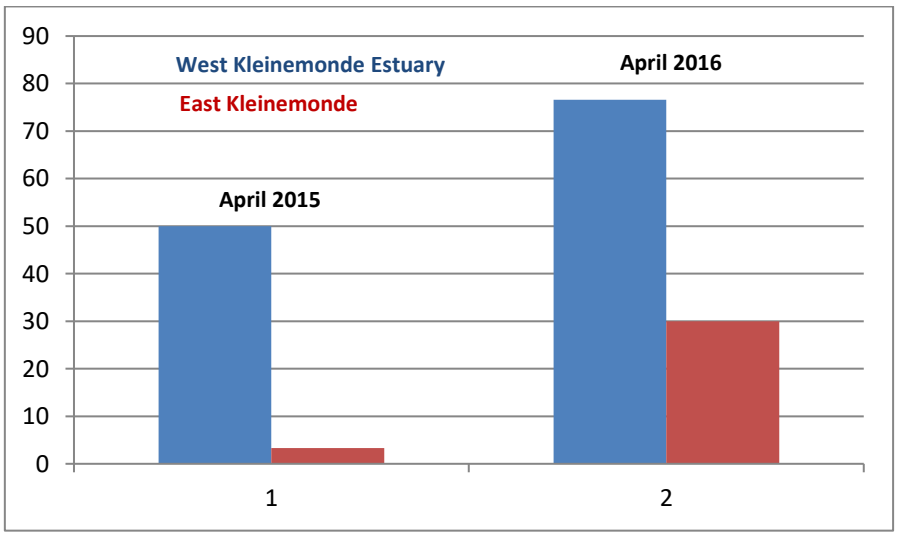

Figure 28. Percentage of month that no flocks were recorded in April 2015 and 2016 by estuary.

The inter-site movements of African Spoonbill are dominated by flocks and not singletons. This suggests that the number of birds counted per day at each study site increases or decreases primarily by the relative size and frequency of flock movements as presented by a range of five thresholds (Table 1, Fig.6 and Fig.7).

Table 1 shows that same-size flocks hardly existed on a daily basis – at least in April 2015 at the West Kleinemonde Estuary. Flock plasticity is a spacio-temporal process of creation, maintenance or extinction within levels of elasticity. This was not the situation in April 2016 that was dominated by the presence of singletons at the East Kleinemonde Estuary. Only in the last week of the month did the West Kleinemonde Estuary reflect the presence of approximate same-size flocks.

As the number of African Spoonbills present increases, flock-size changes tend to take place in the higher threshold orders (Fig.7). Jovani *et al.* (2012: 399) is of the view that "defining colonies is a difficult task […] and largely dependent on subjective decisions". This consideration is also true about flock-size instability and coloniality relationships. This raises the question to what extent African Spoonbill can be considered as 'spatial generalists' (Russell *et al.* 2014: 11).

The last aspect that needs some attention is the so-called 'islands' that appear or disappear with fluctuating estuarine water levels. As an example, figure 11 depicts such 'islands' in the East Kleinemonde Estuary. For the purposes herein, the term micro-habitat is probably more suitable. It is a small highly specialized habitat of restricted size. Its characteristics differ enough (minimum conditions that prevail) from the surrounding larger habitat in that it is specialized enough for African Spoonbill to frequent a these micro-habitats for their specific requirements. Changing water levels, even as little as a few centimetres, significantly influences the relative size of flocks. Such fluctuations are enough to affect immigration, emigration, flock size composition and species richness. These micro-habitats are "unique ecological niches for other [conspecific] species" (Goodale *et al.* 2015: 2). It is therefore not uncommon to find Sacred Ibises (*Threskiornis aethiopicus*) within African Spoonbill flocks.

7. Average monthly African Spoonbill abundance from 1 April 2015 to 31 May 2016 at West Kleinemonde Estuary and East Kleinemonde Estuary

The discussion thus far, covered the African Spoonbill counts of one month but between two years. In addition, the same methodology was used from 1 May 2015 is currently ongoing on a daily basis. The objective is to conduct a long-term study following on the above. In order to round off the previous set of results and link them provisionally with the next 13 months, the daily average per month is presented as follows, with some provisional comments:

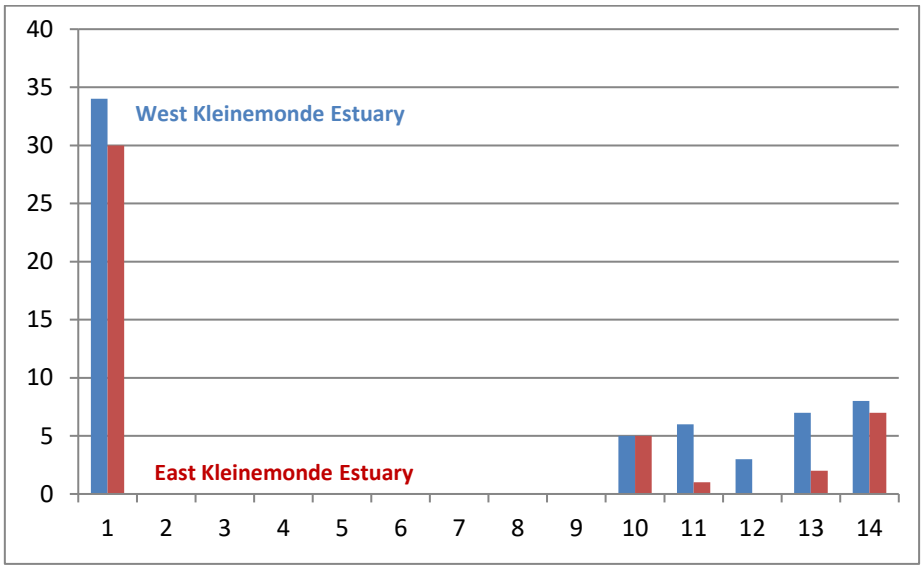

Figure 29. Summary of daily average per month for a 14-month period: 1 April 2015 to 31 May 2016.

Between 2 May 2015 and 23 January 2016, no African Spoonbills visited any of the five sites previously studied (Engelbrecht 2015a). But in the early morning of 23 January 2016, the study area received 24 mm rain and during the following day, five African Spoonbills arrived for the first time in eight months at the West Kleinemonde Estuary. In comparison, the first time after 2 May 2015 when the first African Spoonbills arrived at the East Kleinemonde Estuary, was three days later, on 26 January 2016 when one appeared. If it is correct, as previously proposed (Engelbrecht 2015a) that African Spoonbills follow the rain front, the results of regular African Spoonbill counts as reflected in Table 1, need to be subjected to a third long-term study to substantiate such hypothesis.

7. Conclusions

Despite many studies across a variety of scientific disciplines involving these two estuaries in the past, there is still a need for species-specific research about birds that need to be undertaken.

African Spoonbill shows significant short-term mobility (Table 1) over varying distances (Underhill *et al.* 1999) making their movement behaviour less predictable if researchers were intent to find coherent patters (Table 1, Fig.20 and Fig.22). Temporal scales of small-group (at flock level) location (range of movement) is such that long-term climatic changes e.g. 30-year averages need to be underpinned with comprehensive short-term weather considerations that may be more productive. Are African Spoonbill movements more related to rainfall events than change in seasons? For instance, inter-month and -seasonal changes call for methodological challenges to account for seasonal behavioural changes that

manifest itself in terms of social behaviour, e.g. time of movement, dispersal decisions that relate direction and distance, site preferences and faithfulness, flock-size dynamics, etc.

The characteristics of the rainfall events during March 2015 and 2016 seem not to have been sufficient and immediate necessary causes for African Spoonbill to frequent both estuaries. There are no climatic indicators that seem to suggest that appreciable African Spoonbill influx was eminent. It was only after heavy rainfall during the first two days of April 2015, that African Spoonbills arrived at both estuaries in larger numbers. At one point in time (the middle of the month), practically all African Spoonbills suddenly emigrated from the West Kleinemonde Estuary and joined up with those already present in the East Kleinemonde Estuary. In other words, and in line with the findings about relative weather *vs* climatic influences on bird behaviour, Reside *et al*. wrote: 'we have shown that the weather models also outperformed the climate models for sedentary bird species, suggesting that our weather modelling technique could be beneficial for species more affected by short-term weather fluctuations and variability than long-term averages' (Reside *et al*., 2012). It seems plausible to note that such short-term influences do not stand separate from the importance of the social relationships between African Spoonbill across time-scales.

There is sufficient evidence to show that African Spoonbills move through immigration and emigration at both inter-site and intra-site levels as singletons, pairs, part-flock or full-flocks. After such movements, their behaviour is not necessarily the same at the new location. For instance, Table 1 showed that some African Spoonbills did not return to re-join their previous association (Taylor 2016: 20). Unanswered in this study are the links between the study sites and other water bodies in the sub-region. Where did they come from and what were the push-pull factors that caused their movements? The same holds true for 12 April when East Kleinemonde Estuary Spoonbills emigrated to the West Kleinemonde Estuary on 13 April, then moved back to the East Kleinemonde Estuary by 14 April 2015. This newly elevated numbers on 14 and 15 April 2015, (82 and 93 respectively), suggest that newcomers must have joined those that were already present at the East Kleinemonde Estuary that account for those two sets of high numbers. The conclusion is also that differences if dispersal decisions seems to indicate levels of tolerances relating e.g. diminishing availability of food (Taylor 2016: 21-22). It is unclear if they can tolerate changes in temperature or humidity. Seasonal comparisons over an extended period and different locations would be productive.

The aforementioned implies that from 15 April 2015, the West Kleinemonde Estuary had no more African Spoonbills left. The fluctuations that the East Kleinemonde Estuary experienced for the rest of the month were the result of individuals moving in and out of the East Kleinemonde Estuary's African Spoonbill community. However, there is one exception. On 27 April 2015, 18 African Spoonbills arrived at the West Kleinemonde Estuary for that

day only. It seems to have had no immediate influence on the East Kleinemonde Estuary numbers at the time. They left for an unknown location. Those African Spoonbills from the West Kleinemonde Estuary that emigrated to the East Kleinemonde Estuary in the second half of April 2015 never returned. In our view, this represents a disrupted pattern of consensus in the structural-functionalism of flocking behaviour. There is also merit in hypothesising about the composition of the size of African Spoonbill in nomadic movements – how many and how far do they typically move and what are the mortality reasons and rates?

The above relative group size frequency distribution (Jovani *et al.* 2012: 397-402) fluctuations show noticeable inter- and intra-niche movements that display repeatable behaviour in areas of close proximity. Since African Spoonbills are nomadic the results of this study need to be expanded to be compared with behaviour at other niches further apart. Such attempt would then possibly establish the linkages or network of waterbodies that African Spoonbills frequent and could reveal new information about the nature of such inter-niche movements. The few days between 9 and 17 April 2015, as well as on 27 April 2015, are indicative of such micro inter-niche movements that require a deeper understanding.

A further aspect that was not investigated is within-species repeatability (Jovani *et al.* 2012: 399) of movements, nor that of between-species. For instance, it is not unusual to see African Sacred Ibis (*Threskiornis aethiopicus*) to fly and forage next to African Spoonbills. An interesting case of African Spoonbills on Robbin Island (Van der Westhuizen *et al*. 2014) and studies in Hungary (Végvári *et al.* 2006: 4) illustrate similar behaviour. In addition, April 2015 counts show how the dispersal and nomadic movements of African Spoonbills influence group size. This suggests a complex relationship between group size, population size, and number of colonies, geographic distance, and ecological peculiarities between localities and the relative preference therefor. For instance, a previous argument was that small fluctuating water levels, even as little as 5 cm in height, have an impact on African Spoonbill movement behaviour. In addition, they follow large scale rain fronts (Engelbrecht 2015b: 2). The likelihood of artificial and natural repeatable scarcity of water habitats, denote variables that influence open source ecology, that is, open communities with free movement in and out from the community. This increases or decreases group size distributions of species abundance and richness.

The frequency range of African Spoonbills must also be interpreted against the reality that estuaries form ecological niche networks across geopolitical borders and natural hindrances. Such pose research challenges and have implications for conservation theory and practice. On the one hand, large-scale movements and the actual spatial distribution of small-scale heterogeneities (e.g. in small water regimes), must take into account the existence of heterogeneities of local nature. This might not reflect patters of homogeneous

distribution (Taira and Yomogida 2003: 1531). As a result, micro-habitats for example, represent ecologies that are critical by nature. They are of great importance for African Spoonbill.

African Spoonbills can serve as a species indicator at the West and East Kleinemonde estuaries (and elsewhere). They are sensitive to environmental changes (the nature and scope of such to be researched), are easily noticeable were sampled with relative ease at these two study sites. Their presence, absence and abundance, reflect biological changes of the specific environmental conditions in the ecosystems of these estuaries in the larger eco-universe of interconnected estuarine and other waterbodies. This does not negate the possibility that the correlation between changing environmental conditions somewhere else, are necessarily sufficient cause for their movement to these estuaries and other waterbodies. The challenge is to link their movement behaviour to a scientifically justifiable method and requirement.

Long-term and frequent surveys are beneficial to test various hypotheses. For instance, the flock-size plasticity determines to a large extent the count results and thus theory- and model-building. The differences between April 2015 and 2016 support this, because annual, seasonal and weather-specific schedule priorities are varied. In fact, the FSFD-model has shown how their world changes appreciably when evaluated against the principles of flock-size phenomenon and in the larger context of animal group behaviour. Careful consideration should be given to the conclusion that African Spoonbill populations are structured in flocks (Jovani *et al*. 2007: 2465). The discussion about flock-size plasticity requires caution because of its capacity for ongoing alteration of composition. The above shows the overlapping of three interrelated questions: if food availability at the study sites correlates with predictable seasonal behavioural patterns, were the immigrants local visitors waiting or anticipating the ‘right moment/s’, or, were other immigrants also visitors for the same reasons to the same places, or, were there some the revisit the two study sites from time to time? What is certain is that the last word about inferences regarding African Spoonbill movement ecology has not yet been penned – neither has enough been published about migratory/nomadic pathways (if any) in South Africa and the rest of the continent – making an argument that African Spoonbill research is probably still in its infancy.

Finally, there is a normative side to the empiricism of natural and/or life sciences. Whilst this is a provisional investigation about African Spoonbill at two Eastern Cape estuaries, all such *praxis* takes place in a particular context. This context is the post-Holocene time of our living, *viz.* the Capitalocene. Against the gripping accumulative political-economic powers of capitalism (Turton *et al*. 2003a: 12) humankind should conserve less and not having to conserve more. A previous hypothesis, that ‘there is a propensity to cooperate rather than to fight over shared water resources’ (Turton *et al.* in Turton *et al.* 2003b: 17), is under pressure

given the current lack of service delivery in South Africa (Mc Lennan and Munslow *eds.* 2009). Whereas for some water is a symbol of life, one can argue, that in the South African context, it is also a symbol of shame (Gorbachev in Turton and Henwood *eds.* 2002: 7). If taken into account that by 2025 South Africa will have a population of 70 million and that by then "all its exploitable freshwater resources will be fully exploited" (Hoskin 2010: 2) then there can be no doubt that African Spoonbill will be on the receiving end as a result of increased pressures on their sensitive habitats, the quality of which, are already in decline. As a result, new philosophical underpinnings for traditional conservation biology are required to ensure the continued existence of African Spoonbill in South Africa since there is no evidence to indicate that this (and many other) species would escape the "accumulation by extinction" (Moore in Moore 2016: 8) phenomenon under the current conditions of biospheric instability.

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